

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Hedyotis fluviatilis*

COMMON NAME: Kamapuaa

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: April 2010

STATUS/ACTION

☐ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date:

☒ 12-month warranted but precluded - FR date: May 11, 2005

☐ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

☐ Listing priority change

Former LP: ☐

New LP: ☐

Date when the species first became a Candidate (as currently defined): October 25, 1999

☐ Candidate removal: Former LP: ☐

☐ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

☐ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a

proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act’s definition of “species.”

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Flowering plants, Rubiaceae (Coffee family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Oahu and Kauai

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Oahu and Kauai

LAND OWNERSHIP: On Kauai, three populations of *Hedyotis fluviatilis* occur on State land in the Na Pali Coast State Park and Halelea Forest Reserve (FR), and one population occurs on private land. On Oahu, four populations occur on state land in the Kaipapau FR, the Hauula FR, and Sacred Falls State Park, three populations occur on private lands managed by the U.S. Army as the Kawaihoa Training Area, and one population occurs on private land.

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BIOLOGICAL INFORMATION

Species Description

Hedyotis fluviatilis is a scandent shrub, foetid when bruised; with cylindrical, but slightly flattened, stems, 1 to 8 feet (ft) (0.3 to 2.5 meters (m)) long, glabrous, and with short lateral branches. Leaves are widely spaced, papery, elliptic-oblongate to elliptic-lanceolate, 3.2 to 6.8 inches (in) (8 to 17 centimeters (cm)) long, and 1.2 to 2 in (3 to 5 cm) wide. Flowers are perfect and pistillate, borne in reduced axillary, cymose inflorescences. Calyx lobes are deltate to narrowly ovate, 0.5 to 0.7 in (12 to 18 millimeters (mm)) long, 0.1 to 0.2 in (3 to 6 mm) wide, with several small sac-like glands between corolla lobe sinuses. The corolla is white, fleshy and waxy, with a tube 0.9 to 1.2 in (22 to 30 mm) long. Capsules are woody, strongly quadrangular or winged, 0.3 to 0.5 in (8 to 13 mm) long, and 0.4 to 0.5 in (9 to 13 mm) in diameter. Seeds are translucent reddish brown, wedge-shaped, and minutely reticulate (Wagner *et al.* 1999a, pp. 1,142-1,144).

Taxonomy

First described as *Kadua fluviatilis* by Forbes (1912, p. 6), this species was moved to the genus *Hedyotis* by Fosberg (1943, p. 90), and was recognized as a distinct taxon in Wagner *et al.*

(1999). Terrell *et al.* (2005, pp. 832, 833) placed *Hedyotis fluviatilis* in synonymy with *Kadua fluviatilis*, the earlier, validly published name. There are only minor floral characteristics separating *K. fluviatilis* from *K. acuminata* and further taxonomic studies are needed (Wagner *et al.* 1999a, p. 1,144).

Habitat/Life History

On Kauai, *Hedyotis fluviatilis* is found in mixed native shrubland and wet *Metrosideros* (ohia) lowland forest with the associated native species *Dicranopteris linearis* (uluhe), *Bidens* spp. (kookoolau), *Lobelia niihauensis* (no common name (NCN)), *Hibiscus waimeae* ssp. *hannerae* (kokio keokeo), *Diplazium sandwichianum* (hoio), *Isodendron longifolium* (aupaka), *Machaerina angustifolia* (uki), *Perrottetia sandwicensis* (olomea), *Pipturus albidus* (waimea), *Boehmeria grandis* (akolea), at elevations between 750 and 2,231 ft (229 and 680 m) (Hawaii Biodiversity and Mapping Program (HBMP) 2008); and in open shrubland with sparse tree cover of *Metrosideros polymorpha* (ohia), *Dicranopteris linearis*, *Cibotium glauca* (hapuu), *Sadleria pallida* (amau), *Hedyotis terminalis* (manono), *Antidesma platyphyllum* var. *hillebrandii* (hame), *Bobea brevipes* (ahakea), *Xylosma hawaiiense* (maua), *Cheirodendron fauriei* (olapa), *Melicope feddei* (alani), and *Tetraplasandra* spp. (ohe) (K. Wood, *in litt.* 2005). On Oahu, *H. fluviatilis* occurs in wet *Metrosideros* forest on rocky streambanks with the associated native species *Pritchardia martii* (loulou), *Syzygium sandwicensis* (ohia ha), *Melicope clusiifolia* (kukaemoa), *Scaevola chammissoniana* (naupaka kuahiwi), *Rhynchospora sclerioides* (kuolohia), *Psychotria* spp. (kopiko), *Dicranopteris linearis*, and ferns, at elevations between 820 and 1,990 ft (250 and 607 m) (HBMP 2008).

Historical Range

Historically, *Hedyotis fluviatilis* was found on the island of Kauai in the Haupu mountains; and on the island of Oahu in the northern Koolau mountains ranging from Kaluanui gulch to Kipapa gulch (HBMP 2008).

Current Range/Distribution

Currently, this species is known on Kauai from the northern Na Pali Coast and Halelea Forest Reserve, and in the southern Haupu mountains. On Oahu, *Hedyotis fluviatilis* is found in the northern Koolau mountains, on both the windward and leeward sides, ranging from Koloa gulch to Heleman Stream (HBMP 2008).

Population Estimates/Status

This species is known from 11 populations totaling between 400 and 900 individuals on the islands of Oahu and Kauai (HBMP 2008; Wood 2005, p. 7, National Tropical Botanical Garden (NTBG) 2009). On Kauai, the populations occur at Hoolulu-Hanakapiai (several individuals), Hanakapiai Falls (20 to 30 individuals), Waioli Valley (25 individuals), and Haupu (400 to 500 individuals) (NTBG 2009; S. Perlman, NTBG, pers. comm. 2010). On Oahu, the populations occur at Kaluanui Stream (50 individuals), Maakua and Koloa gulches (50 to 100 individuals, and 8 individuals), Kaipapau Valley (200 to 450 individuals), Kawaiiki Stream (50 to 200 individuals), Opauala Stream (10 to 40 individuals), and Heleman Stream (50 individuals) (HBMP 2008; U.S. Army 2006).

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range. This species is highly threatened by feral pigs and goats that degrade and destroy habitat (HBMP 2008). Evidence of the activities of feral pigs has been reported at the Hanakapiai Falls and Haupu populations of *Hedyotis fluviatilis* on Kauai, and at all of the Oahu populations (Wood, K., NTBG, in litt. 1998; HBMP 2008). Feral goats have been observed at the Hanakapiai Falls population on Kauai (HBMP 2008).

Pigs of Asian ancestry were introduced to Hawaii by the Polynesians, and the Eurasian type was introduced to Hawaii by Cook in 1778, with many other introductions thereafter (Tomich 1986). Some pigs raised as food escaped into the forests of Hawaii, Kauai, Oahu, Molokai, Maui, and Niihau, formed herds, and are now managed as a game animal by the State to optimize hunting opportunities (Tomich 1986, p. 121; State of Hawaii 2001). A study was conducted in the 1980s on feral pig populations in the Kipahulu Valley on Maui (Diong 1982, 408 pp.). This valley consists of a diverse composition of native ecosystems, from near sea level to alpine, and forest types ranging from mesic to wet, *Acacia koa* (koa) to *Metrosideros polymorpha* (ohia). Rooting by feral pigs was observed to be related to the search for earthworms, with rooting depths averaging 8 in (20 cm), greatly disrupting the leaf litter and topsoil layers, contributing to erosion and changes in ground topography (Diong 1982, pp. 143-150). The feeding habits of pigs created seed beds, enabling the establishment and spread of weedy species such as *Psidium cattleianum* (strawberry guava) (Diong 1982, pp. 164-165). The study concluded that all aspects of the food habits of pigs are damaging to the structure and function of the Hawaiian forest ecosystem (Diong 1982, pp. 166-167). The effects on mesic and wet forest habitat by foraging of feral pigs have also been reported in fencing studies. In a fencing study conducted in the montane bogs of Haleakala, it was found that when feral pigs were fenced out of an area the cover of native plant species increased from 6 percent to 95 percent within six years of protection (Loope *et al.* 1991, pp. i, 13).

The goat, a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently, populations exist on Kauai, Oahu, Maui, Molokai, and Hawaii. Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980, p. C20; van Riper and van Riper 1982, pp. 34-35; Scott *et al.* 1986, pp. 352-358; Tomich 1986, pp. 150-156; Culliney 1988, pp. 336-337; Cuddihy and Stone 1990, p. 64). A study conducted at Puuwaawaa on the island of Hawaii demonstrated that prior to management actions in 1985, regeneration of endemic shrubs and trees in an area grazed by feral ungulates was almost totally lacking, contributing to the invasion of the forest understory by exotic grasses and weeds. After the removal of grazing animals in 1985, *Acacia koa* and *Metrosideros* spp. (ohia) seedlings were observed germinating by the thousands (Department of Land and Natural Resources 2002, p. 52).

Hawaiian ecosystems, having evolved without hooved mammals, are susceptible to large-scale disturbance by feral pigs, goats, and other introduced ungulates (Loope *et al.* 1991, p. 3). Because of demonstrated habitat modifications by feral pigs and goats such as destruction of

native plants, disruption of topsoil leading to erosion, and establishment and spread of nonnative plants; the Service believes they are a threat to *Hedyotis fluviatilis*.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

None known.

C. Disease or predation.

Predation by feral pigs and goats is a likely threat to *Hedyotis fluviatilis* as evidence of the activities of feral pigs has been reported at almost all the known populations, and activities of feral goats has been reported at the Hanakapiai Falls population on Kauai. In a study conducted in the 1980s, feral pigs were observed browsing on young shoots, leaves and fronds of a wide variety plants, of which over 85 percent were endemic species (Diong 1982, p. 138). A stomach content analysis in this study showed that the pigs' food sources consisted of native plants, 60 percent of which were *Cibotium* spp. (tree ferns), alternating with *Psidium cattleianum* (strawberry guava) when it was available. Feral pigs were observed to fell plants and remove the bark of *Clermontia*, *Cibotium*, *Coprosma*, *Psychotria*, and *Hedyotis* species, with larger trees killed over a few months of repeated feeding (Diong 1982, pp. 138, 144). Goats browse on introduced grasses and native plants, and are able to reach more remote and inaccessible areas than other ungulates. They thrive on a variety of food plants, and are instrumental in the decline of native vegetation in many areas (Cuddihy and Stone 1990, pp. 48, 104).

Browsing by ungulates has been observed on many other native species, including common and rare or endangered species (Cuddihy and Stone 1990, pp. 63-67; Loope *et al.* 1991); therefore it is likely that feral pigs and goats impact this species directly as well as the surrounding habitat.

D. The inadequacy of existing regulatory mechanisms.

Hedyotis fluviatilis currently receives no protection under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544).

Pigs and goats are managed as game animals in Hawaii, but many populate inaccessible areas where hunting is difficult, if not impossible, and therefore has little effect on their numbers (Hawaii Heritage Program 1990, p. 3). Pig and goat hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources 1999, 2003); however, public hunting is not adequate to eliminate this threat to *Hedyotis fluviatilis*.

E. Other natural or manmade factors affecting its continued existence.

Alien plant species highly threaten *Hedyotis fluviatilis* as they degrade habitat and outcompete native species (HBMP 2008; Wood, K., *in litt.* 1998). The nonnative plants reported to be the greatest threat to *H. fluviatilis* on Kauai are: *Kalanchoe pinnata* (air plant), *Clidemia hirta* (Koster's curse), *Hedychium gardnerianum* (kahili ginger), *Blechnum appendiculatum* (no common name (NCN)), and *Psidium guajava* (common guava) at the Kalalau-Hoolulu population; *Psidium guajava*, *Aleurites moluccana* (kukui), *Passiflora tarminiana* (banana poka), *Cordyline fruticosa* (ki, ti), *Clidemia hirta*, and *Lantana camara* (lantana) at the Hanakaipiai Falls population; and *Lantana camara*, *Rubus rosifolius* (thimbleberry), *Schinus terebinthifolius* (Christmas berry), and *Pluchea* sp. (Indian fleabane, sourbush) at the Haupu population (HBMP

2008). The nonnative plants that are the major threats to *H. fluviatilis* on Oahu are: *Psidium cattlium* (strawberry guava), *Clidemia hirta*, *Schinus terebinthifolius*, *Pterolepis glomerata* (false meadowbeauty), and *Rubus rosifolius* at all of the populations (Wood, K., *in litt.* 1998; HBMP 2008).

Aleurites moluccana is a spreading tree 33 to 65 ft (10 to 20 m) tall, native to Malesia, and considered a Polynesian introduction to Hawaii. It is now a significant component of the mesic valley vegetation from sea level to 2,300 ft (700 m) on all the main islands (Wagner *et al.* 1999a, p. 598). This species favors moist valleys; however, it is now growing in seemingly totally inaccessible spots (Pacific Island Ecosystems at Risk (PIER) 2006a). The Hawaii Weed Risk Assessment Protocol, based on information on the biology of the species obtained from scientific literature and other documented sources used to predict likely invasiveness of a plant species places *A. moluccana* in the high risk category.

Blechnum appendiculatum is a fern native to tropical America. Fronds are 8 to 23 in (20 to 60 cm) long, with younger fronds colored pink to rosy. Clones form large colonies in closed-canopy mesic forests, and occur in all but the most extreme habitats. It was first collected in Hawaii in 1918, and has spread extensively. It is a serious weed and competes with many native fern species (Palmer 2003, pp. 79-81).

Clidemia hirta is a noxious shrub first cultivated on Oahu before 1941. This pest plant forms a dense understory, shading out native plants and hindering their regeneration, and is considered a serious plant threat (Wagner *et al.* 1985, p. 41; Smith 1989, p. 189). The most promising biological control to date for *C. hirta* is the *Colleotrichum* fungus, *Gloesporioides* f. sp. *clidemiae*, released in 1986. Although there is no quantitative data available, it has an observable negative impact. Other agents tested were a moth (*Antiblemma acclinalis*), a leaf-feeding beetle (*Lius poseidon*), a fruit and flower-feeding insect (*Mompha trithalama*), and a terminal growth-feeding insect (*Liothrips urichi*), all with lesser control success than the fungus (Smith 1989, p. 189).

Cordyline fruticosa is a shrub 6.6 to 11.5 ft (2 to 3.5 m) tall, and is considered a Polynesian introduction to Hawaii. It was extensively cultivated and occurs widely in mesic valleys and forests (Wagner *et al.* 1999a, pp. 1,348-1,350). It can become a dominant element of the understory (Hawaii Department of Land and Natural Resources 1989, p. 10).

Hedychium gardnerianum is native to India (Nagata 1999). This showy ginger was introduced for ornamental purposes, and was first collected on Hawaii Island in 1954 (Wester 1992). Kahili ginger grows over 3.3 ft (1 m) tall in open light environments, preferring a warm moist climate; however it will readily grow in full shade beneath a forest canopy (Smith 1985). It forms vast, dense colonies, displacing other plant species, and reproduces by rhizomes. The conspicuous, fleshy, red seeds are dispersed by fruit-eating birds as well as man. Aircraft-based analysis shows that kahili ginger reduces the amount of nitrogen in the *Metrosideros* forest canopy in Hawaii, a finding subsequently corroborated by ground based sampling (Asner and Vitousek 2005). It may also block stream edges, altering water flow (Global Invasive Species Database 2006a). Kahili ginger can be controlled by herbicides, but biological control is considered the only practical approach for the long-term management of large infestations in native forests. The

ability of the bacterium *Ralstonia* (= *Pseudomonas*) *solanacearum* to cause bacterial wilt in Kahili ginger in the field, together with its lack of virulence in other ginger species, contributes to its potential as a biological control agent (Anderson and Gardner 1999; Anderson 2003).

Kalanchoe pinnata is an herb which is widely established in many tropical and subtropical areas. Naturalized in Hawaii prior to 1871, it is abundant in low elevation disturbed areas on all the main islands except Niihau and Kahoolawe (Wagner *et al.* 1999, p. 568). The air plant can reproduce vegetatively at indents along the leaf, usually after the leaf has broken off the plant and is lying on the ground, where a new plant can take root. *Kalanchoe pinnata* can form dense stands that prevent reproduction of native species (Starr 2006).

Lantana camara, brought to Hawaii as an ornamental plant, is an aggressive, thicket-forming shrub which is now found on all of the main islands in mesic forest, dry shrubland, and other disturbed habitats (Wagner *et al.* 1999a, p. 1,320). The most effective control agents are the lace bug *Teleonemia scrupulosa* Stal. (Tingidae); the chrysomelid beetles *Octotoma scabripennis* Guerin-Meneville and *Uroplata girardi* Pi; the moths *Hypena strigata* F., *Neogalea sunia* (Guenée) (Noctuidae), and *Salbia haemorrhoidalis* Guenée (Pylalidae). While biological control of lantana by most of the established insects appeared to have reached equilibrium by 1969, the overall impact of the phytophage complex has been a steady and considerable reduction in abundance of the weed, particularly in drought-prone areas. Although lantana is considered generally to be under partial to substantial control in drier areas, it still remains a pest in some other environments, such as national parks (Department of Agriculture 2006).

Passiflora tarminiana, a vine native to South America, is widely cultivated for its fruit (Escobar 1999, p. 1,012). First introduced to Hawaii in the 1920s, it is now a serious pest in mesic forest, where it overgrows and smothers the forest canopy. Seeds are readily dispersed by humans, birds, and feral pigs (LaRosa 1992, pp. 272-274, 281). Fallen fruit encourage rooting and trampling by pigs (Diong 1982, p. 160). Field releases of biocontrol insects have not been successful, but testing of fungi as biocontrol of this vine is ongoing (Gardner 2005).

Pluchea sp. There are two species of *Pluchea* in Hawaii, *P. indica* and *P. carolinensis*, and a cross between them (*Pluchea* x *fosbergii*). *Pluchea indica* is native to southern Asia, and *P. carolinensis* is native to Mexico, the West Indies, and South America (Wagner *et al.* 1999a, pp. 350-351). This 3 to 6 ft (1 to 2 m) tall, fast-growing shrub, forms thickets in dry habitats and can tolerate saline conditions. It is widespread in Hawaii from coastal areas up to almost 3,000 ft (900 m). The seeds are wind-dispersed (Francis 2006).

Psidium cattleianum, a tree native to tropical America, has become widely naturalized on all the main islands of Hawaii. Found in mesic to wet forests, strawberry guava develops into dense stands in which few other plants can grow, displacing native vegetation. The fruit is eaten by pigs and birds, which then disperse the seeds throughout the forest (Smith 1985, p. 200; Wagner *et al.* 1985, p. 971). A biological control agent, *Tectococcus ovatus*, has undergone 15 years of testing, and there is a proposal to release this insect at Olaa Forest Reserve (ScienceDaily 2008).

Psidium guajava, a small shrub or tree native to the Neotropics, is naturalized in Hawaii and forms dense stands in disturbed forest. It is not as common as *P. cattleianum*. The seeds are

spread by feral pigs and alien birds (Wagner *et al.* 1999a, p. 972). Extensive stands of young trees can be controlled through burning, as cutting results in regrowth with multiple stems. Regeneration from underground parts by suckering limits the effectiveness of manual control. Trees grown from seed produce fruit in two to four years, with a life expectancy of 30 to 40 years (Global Invasive Species Database 2006b).

Pterolepis glomerata is an herb or subshrub in the Melastomataceae family. It is native to tropical regions of eastern South America. In Hawaii it is naturalized in mesic to wet disturbed sites and trail margins on Kauai, Oahu, Molokai, and Hawaii. All members of this genus are declared noxious in the State of Hawaii ((HAR Title 4, Subtitle 6, Chapter 68). The basis for this genus being classed as invasive are the plants' adaptations such as high germination rates, rapid growth, early maturity, ability of fragments to root, possible asexual reproduction, and efficient seed dispersal, especially by birds that are attracted by copious production of berries (University of Florida Herbarium 2006).

Rubus rosifolius is native to Asia and is common in Hawaii in disturbed mesic to wet forest on all of the main islands. It is covered with prickles and has edible red fruit. It invades the understory, forms dense thickets, and outcompetes native plant species. It easily reproduces from roots left in the ground and seeds are spread by feral animals and birds. There is no specific management information for *R. rosifolius*, but techniques used for the control of blackberry *R. fruticosus*, a related species, may be applicable (PIER 2006b; Global Invasive Species Database 2006c).

Schinus terebinthifolius, a shrub native to Brazil, was introduced to Hawaii in 1911 and is now naturalized in mesic areas (Wagner *et al.* 1999a, p. 198). It forms dense thickets and grows on steep slopes, and the red berries are attractive to birds (Smith 1989, p. 63). Seedlings grow very slowly and can survive in dense shade, exhibiting vigorous growth if the canopy is cleared, leading to the creation of open habitat and further influencing and increasing its rate of spread (Brazilian Pepper Task Force 1997, p. 8). *Schinus terebinthifolius* is also a relative of poison ivy and may cause allergic skin reactions on sensitive persons. There are no released biocontrol agents to date (Brazilian Pepper Task Force 1997, p. 12). This species is on the Hawaii noxious weed list (HAR Title 4, Subtitle 6, Chapter 68).

The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985, p. 180; Wagner *et al.* 1999a, p. 45). Confirmed personal observations (Wood, K., *in litt.* 1998) and several studies (Cuddihy and Stone 1990, p. 74; Robichaux *et al.* 1998, p. 4) indicate nonnative plant species may outcompete native plants similar to *Hedyotis fluvialis*. Competition may be for space, light, water, or nutrients, or there may be a chemical produced that inhibits growth of other plants (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smith 1985, pp. 227-230; Loope and Medeiros 1992, pp. 7-8; Medeiros *et al.* 1992, p. 30; Ellshoff *et al.* 1995, pp. ii, 3-4; Meyer and Florence 1996, p. 778; Medeiros *et al.* 1997, pp. 23-24; Loope *et al.* 2004, pp. 6-10). In particular, alien pest plant species degrade habitat by modifying availability of light, altering

soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985, pp. 227-230; Cuddihy and Stone 1990, p. 74; Vitousek *et al.* 1997, pp. 6-10). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the mesic to wet forest habitat of *H. fluviatilis*, the Service believes nonnative plant species are a threat to *H. fluviatilis*.

Randomly occurring natural events such as landslides and hurricanes are a threat to the Kauai populations of *Hedyotis fluviatilis* (HBMP 2008).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

This species is represented in an ex situ collection at Lyon Arboretum (N. Sugii, Lyon Arboretum, pers. comm. 2006; NTBG 2006). The National Tropical Botanical Garden has outplanted one individual in Limahuli Valley (NTBG 2008, p. 8). There are no other known conservations measures implemented to date for *Hedyotis fluviatilis*.

SUMMARY OF THREATS

Based on our evaluation of habitat degradation and loss by feral pigs, goats, and nonnative plants, we conclude there is sufficient information to develop a proposed listing rule for this species due to the present and threatened destruction, modification, or curtailment of its habitat and range, and the displacement of individuals of *Hedyotis fluviatilis*, due to competition with nonnative plants for space, nutrients, water, air, and light. Predation by feral pigs and goats, and randomly occurring natural events such as landslides and hurricanes, are likely threats to *H. fluviatilis*. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

*The taxonomic validity of this species should be resolved before developing a proposed listing rule.

RECOMMENDED CONSERVATION MEASURES

- Survey for populations of *Hedyotis fluviatilis* in areas of potentially suitable habitat
- Conduct further taxonomic study
- Control feral pigs and goats
- Control alien plants
- Continue propagation efforts for maintenance of genetic stock
- Reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2*
	Non-imminent	Subspecies/population	3
		Monotypic genus	4
		Species	5
Moderate to Low	Imminent	Subspecies/population	6
		Monotypic genus	7
		Species	8
	Non-imminent	Subspecies/population	9
		Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

This species is highly threatened by feral pigs and goats that degrade and destroy habitat and by nonnative plants that outcompete and displace it. Likely threats to this species include predation by feral pigs and goats, and randomly occurring natural events such as landslides and hurricanes. Threats to the mesic to wet forest habitat of *Hedyotis fluviatilis* occur throughout its range, and are expected to continue or increase without their control or eradication.

Imminence:

Threats to *Hedyotis fluviatilis* from feral pigs, goats, and nonnative plants are imminent because they are ongoing.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent further losses that may result in this subspecies' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *Hedyotis fluviatilis* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING

The information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December 1995. We incorporated additional new information on this species from information in our files and from the *Manual of the Flowering Plants of Hawaii* (Wagner *et al.* 1999a). In 2004, the Pacific Islands Office contacted the following species experts: Robert Hobdy, retired from the Hawaii Division of Forestry and Wildlife; Joel Lau, Hawaii Natural Heritage Program; Arthur Medeiros, U.S.G.S. Biological Resources Discipline; Hank Oppenheimer, resource manager for the Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, National Tropical Botanical Garden. No new information was received. In 2005 we contacted species experts, but received no new information on this taxon. In 2006 new status information was provided by Nellie Sugii, Lyon Arboretum, and was incorporated into this assessment. No new information was received in 2008 and 2009. In 2010, we contacted the species experts listed below, and received new information from Steve Perlman (NTBG), and Kapua Kawelo (U.S. Army Environmental).

List all experts contacted:

Name	Date	Affiliation
Agorastos, Nick	02/09/10	Hawaii Division of Forestry and Wildlife
Anderson, Stephen	02/09/10	National Park Service, Haleakala NP, Maui
Aruch, Sam	02/09/10	Private contractor
Bakutis, Ane	02/09/10	Plant Extinction Prevention Program, Molokai
Ball, Donna	02/09/10	U.S. Fish and Wildlife Service, Hawaii Island
Beavers, Sally	02/09/10	National Park Service, Hawaii Island
Bily, Pat	02/09/10	The Nature Conservancy, Maui
Bio, Kealii	02/09/10	Plant Extinction Prevention Program, Hawaii Island
Brosius, Chris	02/09/10	West Maui Mountains Watershed Partnership
Caraway, Vickie	02/09/10	Hawaii Division of Forestry and Wildlife, Oahu
Ching, Susan	02/09/10	Plant Extinction Prevention Program, Oahu
Cole, Colleen	02/09/10	Three Mountain Alliance
Conry, Paul	02/09/10	Hawaii Division of Forestry and Wildlife
Coordinator	02/09/10	East Maui Watershed Partnership
Duvall, Fern	02/09/10	Hawaii Division of Forestry and Wildlife, Maui
Fay, Kerri	02/09/10	The Nature Conservancy, Maui
Garnett, Bill	02/09/10	National Park Service, Kalaupapa, Molokai
Giffin, Jon	02/09/10	The Nature Conservancy, Hawaii Island
Haus, Bill	02/09/10	National Park Service, Haleakala NP, Maui
Higashino, Jennifer	02/09/10	U.S. Fish and Wildlife Service, Maui
Imada, Clyde	02/09/10	Bishop Museum
Jacobi, Jim	02/09/10	U.S.G.S.-Biological Resources Discipline
Kawakami, Galen	02/09/10	Hawaii Division of Forestry and Wildlife, Kauai
Kawelo, Kapua	02/09/10	U.S. Army, Environmental Division
Kier, Matt	02/09/10	U.S. Army, Environmental Division
Kiyabu, Brian	02/09/10	Amy Greenwell Botanical Garden
Kraus, Jim	02/09/10	U.S. Fish and Wildlife Service, Hakalau NWR
Medeiros, Arthur	02/09/10	U.S. G.S.-Biological Resources Discipline

Misaki, Ed	02/09/10	The Nature Conservancy, Molokai
Moriyasu, Patty	02/09/10	Volcano Rare Plant Facility, Hawaii Island
Moses, Wailana	02/09/10	The Nature Conservancy, Molokai
Nakai, Glynnis	02/09/10	U.S. Fish and Wildlife Service Maui Refuges, Maui
Oppenheimer, Hank	02/09/10	Plant Extinction Prevention Program, Maui Nui
Palomino, Anna	02/09/10	Olinda Rare Plant Nursery, Maui
Palumbo, David	02/09/10	National Park Service, Haleakala NP, Maui
Pepi, Vanessa	02/09/10	U.S. Navy, Environmental Contractor
Perlman, Steve	02/09/10	National Tropical Botanical Garden
Perry, Lyman	02/09/10	Hawaii Division of Forestry and Wildlife, Hawaii Island
Plunkett, Bryan	02/09/10	Lanai Forest and Watershed Partnership
Pratt, Linda	02/09/10	U.S.G.S.-Biological Resources Discipline
Purell, Melora	02/09/10	Kohala Watershed Partnership
Seidman, Stephanie	02/09/10	Maui Nui Botanical Garden
Shishido, Glenn	02/09/10	Hawaii Division of Forestry and Wildlife, Maui
Silbernagle, Mike	02/09/10	U.S. Fish and Wildlife Service, Oahu NWR Complex
Smith, Miranda	02/09/10	Koolau Mountains Watershed Partnership
Starr, Forest	02/09/10	U.S.G.S.-Biological Resources Discipline
Tanaka, Daniel	02/09/10	Puu Kukui Watershed Preserve
Ward, Joe	02/09/10	Puu Kukui Watershed Preserve
Welton, Patti	02/09/10	National Park Service, Haleakala NP, Maui
Wood, Ken	02/09/10	National Tropical Botanical Garden
Wysong, Michael	02/09/10	Hawaii Natural Area Reserve System, Kauai

The Hawaii Biodiversity and Mapping Program identified this species as critically imperiled (HBMP 2006). Based on the International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, this species is recognized as Rare (could be considered at risk) by Wagner *et al.* (1999b, p. 46). *Hedyotis fluviatilis* is not included in Hawaii's 2005 Comprehensive Wildlife Conservation Strategy (Mitchell *et al.* 2005, 722 pp.).

COORDINATION WITH STATES

On February 11, 2010, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No additional information or comments were received.

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:

Acting Cecily A. Bohan 5/18/10
Regional Director, Region 1, Fish and Wildlife Service Date

Ronan W. Gould
ACTING
Director, Fish and Wildlife Service October 22, 2010

Concur:

Do not concur: _____ Date: _____
Director, Fish and Wildlife Service

Director's Remarks:

Date of annual review: _____ Date: April 5, 2010
Conducted by: Cheryl Phillipson, Pacific Islands FWO
Biologist, Prelisting and Listing Program

Comments:

PIFWO Review

Reviewed by: Christa Russell Date: April 22, 2010
Prelisting and Listing Program Coordinator

Marilet Zablan Date: April 26, 2010
Assistant Field Supervisor, Endangered Species

Gina Shultz Date: April 30, 2010
Acting Field Supervisor